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Impact of income, trade, urbanization, and financial development on CO_2 emissions in the GCC countries

Lassad Ben Dhiab *, Hichem Dkhili

College of Business Administration (CBA), Northern Border University, Arar, Saudi Arabia

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ABSTRACT

This study aims to explain the relationship between income, trade, urbanization, and financial development towards the degree of carbon dioxide emissions. The main purpose of the research is an econometric model which tries to study the interaction between the level of carbon dioxide emissions with income, trade, urbanization, and financial development. Through a study based on a sample composed of the Gulf Cooperation Council (GCC) countries. We propose an empirical investigation based on the use of econometric modeling, cointegration techniques, and the Granger causality test and the VECM. By using a panel sample composed of the Gulf Cooperation Council (GCC) countries from the period 1995 to 2016 the results prove a positive and significant long term relationship between income, trade, urbanization, and financial development and CO_2 emissions. Also, the results denote that a higher level of country income and urbanization generates a high level of CO_2 emissions. Afterward, financial Development had a positive effect on CO_2 emission level. And finally, trade openness influences negatively the CO_2 emissions.

1. Introduction

Since 1750, scientists have warned that the oceans absorb about 30 percent of the carbon dioxide produced by humans. It increases the salinity of seawater. Also, during the year 1970, the oceans are also affected by climate change and absorb about 90 percent of the extra heat produced by industrial communities, making it difficult for the oceans to retain oxygen.

In this context, countries have taken an interest in this aspect by encouraging the preservation of the environment and introducing the potential consequences of the dramatic changes in the environment, as well as highlighting the ocean in the international talks. The International Energy Agency (IEA) said that carbon dioxide emissions hit a record high last year. International emissions rose again after falling because of the financial crisis that hit the global economy in 2009 and ended 5 percent of the 2008 high emissions.

In these recent years, countries have been urging the so-called green economy to be reduced and incentives to promote environmentally friendly projects. The Kuznets curve graphs support the argument that as the economy evolves and market forces first increase and then reduce economic inequality. The Kuznets ecological curve (EKC) had acquired a distinctive feature in the literature of politics Environmental and almost the beginning of all applied research and experimental. Many theoretical researches had confirmed a causal link between income, trade, urbanization, and financial development with carbon dioxide emissions.

While, some others studies had concluded that relatively liberal environmental regulations in developing countries had a negative impact on quality of life. For example, the study of Saidi and Mbarek (2017), Dkhili and Dhiab (2018), Boutabba (2014), Shahbaz et al. (2013), Salahuddin et al. (2015), Bekhet and Othman (2017), Liu et al. (2017), Dasgupta et al. (2006), Ouyang and Lin (2017), He et al. (2017a), and finally Zhang et al. (2015).

Another set of applied works had addressed the same problem with Granger's methodology for testing causal relationships between income, trade, urbanization, and financial development with carbon dioxide emissions. Such as Wang et al. (2018) studies had analyzed the effects of economic growth and urbanization on various industrial carbon emissions. Dogan and Aslan (2017), Zhang et al. (2015), and

* Corresponding Author.
Email Address: blassad19@yahoo.com (L. B. Dhiab)
https://doi.org/10.21833/ijaas.2019.07.005
Corresponding author's ORCID profile:
https://orcid.org/0000-0001-5773-1494

Makido et al. (2012) had proposed a comprehensive study of the role of renewable energy consumption and its institutions towards economic growth and carbon dioxide emissions.

Furthermore, the emergence of harmful climate problems, especially the problems of CO_2 emissions, stimulates the questioning of the nature of the relationship between income, trade, urbanization and financial development with the degree of CO_2 emissions.

Moreover, the Kuznets curve graphs (Kuznets curve graphs) had supported the assertion that as the economy develops; market forces first increased and then reduced economic inequality. Later, the EKC has gained a distinctive feature in the literature of environmental policy and has been the beginning of all applied and experimental research, especially since the early 1990s with the high increase in emissions of harmful gases to the environment.

Actually, a range of research had studied the relationship of income, trade, urbanization, and financial development to carbon dioxide emissions. And another's large authors groups talked about the negatives effects of carbon dioxide emissions. Indeed, we explore these debates and examine the link between income, trade, urbanization, financial development and carbon dioxide emissions.

Yet, our problematic is: What is the relationship between income, trade, urbanization, and financial development on carbon dioxide emissions?

2. Literature review

A set of theoretical and applied studies had analyzed the quality of relationships between the impact of financial development, income, trade openness and urbanization on CO 2 emissions. The studies of Fan et al. (2017) had focused on the relationship between urbanization and carbon dioxide emissions on a sample made up of China. Saidi and Mbarek (2017) examined the impact of financial development, income, trade openness, and urbanization on carbon dioxide emissions for the panel of emerging economies using the time series data over the period 1990–2013.

Their Results showed a positive monotonic relationship between income and CO_2 emissions. Financial development minimizes environmental degradation. The urbanization decreases the CO_2 emissions. And they conclude that it is important for the policymakers and urban planners in these countries to slow the rapid increase in urbanization. Boutabba (2014) had studied the existence and direction of a causal relationship between carbon emissions, financial development, economic growth, energy consumption and trade openness for India. The results suggest that there is evidence on the long-run and causal relationships between carbon emissions, financial development, income, and energy use and trade openness. And financial development had a long-run positive impact on carbon emissions.

Finally, the authors had recommended that the financial system should take into account the environment aspect in their current operations. Shahbaz et al. (2013) had analyzed the evidence to answer to the question whether financial development reduces CO_2 emissions or not in the case of Malaysia. The empirical result indicates that financial development reduces CO_2 emissions. The results of Shahbaz et al. (2013) shown that the Granger causality analysis reveals the feedback hypothesis between financial development and CO_2 emissions, energy consumption and CO_2 emissions and, between CO_2 emissions and economic growth. The purpose of Shahbaz et al. (2013) had interested to the effects of financial development, economic growth, coal consumption and trade openness on environmental performance using time series data over the period 1965–2008 in case of South Africa. And found empirically a long run relationship among the variables. In addition, the author's results showed that a rise in economic growth increases energy emissions, while financial development reduces it. Coal consumption has significant contribution to deteriorate environment in South African economy. Trade openness improves environmental quality by reducing the growth of energy pollutants. Salahuddin et al. (2015) had explored the relationship between carbon dioxide emissions, economic growth, electricity consumption and financial development in the Gulf Cooperation Council (GCC) countries. Their findings imply that electricity consumption and economic growth stimulate CO_2 emissions in GCC countries while financial development reduces it. And Granger causality results had revealed that there is a bidirectional causal link between economic growth and CO_2 emissions and a unidirectional causal link running from electricity consumption to CO_2 emissions. Finally, they concluded that there is no causal link between financial development and CO_2 emissions. Shuai et al. (2017) have tried to provide a global picture of the carbon emissions. By identifying the turning point of 164 countries and five panel groups, there results shown those 123 individual countries and all the five panel groups accept the carbon Kuznets curve (CKC) hypothesis. Bekhet and Othman (2017) had examined the relationships among CO_2 emissions, urbanization growth, energy consumption, GDP, domestic investment, and financial development. And they had captured a bidirectional causality among energy consumption, domestic investment, GDP, CO_2 emissions, and unidirectional causality from financial development to CO_2 emissions at least at a 5 percent level of significance. For Liu et al. (2017) urbanization is directly drives rural to urban population migration and indirectly causes west to east migration in China, they analyzed these two phenomena by turning emissions into a per capita term, and extending the impact from the traditional urbanization rate effect to include population density effect. Their results shown that population density had actually been the dominant demographic player in changing per capita

emissions for the past two decades. The study of Chang and Li (2017) had incorporated the demand emission sensitivity into a programming model to explore the issue of decoupling the lock-in effect between economic growth and CO_2 emissions through structure adjustment from a final demand perspective. As a demonstration, the authors had proposed a methodology that applied to data from China for the year 2012. The results had indicated that to formulate better carbon mitigation policies, we should pay more attention to the main internal linkages in terms of CO_2 emissions within the economy.

Dasgupta et al. (2006) had inspected the reaction of investors to the publication of these lists, and show that enterprises appearing on these lists have experienced a significant decline in their market valuation. Ouyang and Lin (2017) had conducted a comparative study between China and Japan at the urbanization stages to analyze the similarities as well as differences of influencing factors of CO_2 emissions. This Results had indicated that although CO_2 emissions in Japan and China showed the similar characteristics of rigid growth during the urbanization processes, significant differences exist in factors such as CO_2 emissions per capita, energy structure and energy intensity between the two countries, which are the determinants for CO_2 emissions growth.

Wang et al. (2018) had focused on the impact factors of carbon dioxide emission as population, economy, technology and others. And they had utilized a model to examine the impact of population size, per capita consumption, energy intensity, urbanization and aging population on CO_2 emissions by adopting panel data of 30 provinces from 1997 to 2012. And with taking the climate change as a control variable, finally, the author's results that the population size, per capita consumption and energy intensity have a strong explanatory power on CO_2 emissions in the three regions. Dogan and Aslan (2017) had developed a relationship among carbon emissions, real income, energy consumption and tourism for a panel of the EU and candidate countries over the period 1995–2011 by using heterogeneous panel estimation techniques with cross-sectional dependence. The Results had indicated the presence of a long run relationship among the analyzed variables. And they had revealed that, energy consumption had contributed to the level of emissions while real income and tourism mitigate CO_2 emissions. He et al. (2017b) had tested the relationship between urbanization and the eco-environment in Shanghai, using data from 1980 to 2013. The comprehensive level of Shanghai's urbanization process during the study period was estimated using an index composed of four primary indicators, namely: demographic urbanization, spatial urbanization, social urbanization, and economic urbanization. We had also developed an index system for the eco-environment, which was based on four primary indicators: the environmental level, eco-environmental endowment, eco-environmental pressure and eco-environment response.

Zhang et al. (2015) had concentrated him study on a panel data of 141 countries over the period of 1961–2011, this paper analyzed the impact of urbanization on carbon dioxide emissions empirically. They had employed two-way fixed effects model based on the extended theoretical frameworks. Theirs results shown that there is an inverted U-shaped relationship between urbanization and carbon emissions and the turn point is around 73.80%. But excessive urban concentration can claim the benefits of high-level urbanization. These findings can also helped policy makers to use efficient urbanization to curb the carbon emissions, especially for the Asian countries that with high density of population. The studies of Wang et al. (2018) had attempted to examine the impacts of economic growth and urbanization on various industrial carbon emissions. Through investigation of the existence of an environmental Kuznets curve, the study had explored the income/urbanization and disaggregated industrial carbon dioxide emissions nexus, using panel data together with semi-parametric panel fixed effects regression referred to a panel of China spanning the period (2000–2013). Wang et al. (2018) had tried to calculate the accurate of CO_2 emissions in every province in China. And propose an approach to recalculate provincial CO_2 emissions from the perspective of secondary energy consumption. Bhattacharya et al. (2017) had provided a comprehensive and robust analysis of the role of renewable energy consumption and institutions on economic growth and in combating CO_2 emissions across the regions and income groups. By using annual data from 85 developed and developing economies over the period from 1991 to 2012. The authors employed a various econometric technique from panel estimations to obtain the robust results. They result that the growth of renewable energy consumption had a significant positive and negative impact on economic output and CO_2 emissions, respectively. Institutions had a positive influence on economic growth and a reducing effect on CO_2 emissions. And they suggested that both renewable energy deployment and institutions are significant in promoting economic growth and reducing CO_2 emissions. Fan et al. (2017) had evaluated the relationship among urbanization, energy consumption and CO_2 emissions. The findings of this study shown, that the urbanization process had contributed to an improvement of residential energy consumption structure. Zhang et al. (2015) had examined the residential direct CO_2 emissions of Shanxi in China, and had focused on the effects of three household-related factors and urbanization. Zi et al. (2016) had evaluated the relationship between urbanization and CO_2 emissions. These authors had employed a regression to analyze the variations in CO_2 emissions as urbanization progresses. They found that emissions increased more quickly after urbanization variables reach their threshold point.

Through the review of literature, we can advance our hypothesis:

H1: There is a relationship between income, trade, urbanization, financial development and CO_2 emissions.
H2: A higher level of country income generates a high level of CO_2 emissions.
H3: A higher level of country Urbanization generates a high level of CO_2 emissions.
H4: Financial Development had a positive effect on CO_2 emission level.
H5: Openness trade influences negatively the CO_2 emissions.

3. Empirical analysis

3.1. Methodology and data collection

In the empirical analysis, we provide firstly data and methodology. Secondly, we specify our econometric model and we defined variables. Later, we present the correlation coefficients between variables. Finally, we discuss with the empirical findings.

3.1.1. Sample

To test the relationship between incomes, trade, urbanization, financial development and carbon dioxide emissions during the period (1995-2016) for the GCC countries.

3.2. Empirical model and data sources

The empirical model contains five variables such as: income (Y), OPEN is a measure of the trade openness, Urbanization (URB), financial development (FD) and CO_2 emissions (C). The data used in this study are collected the World Bank (WDI) and from Carbon Dioxide Information Analysis Center. To resolve the problem of heteroscedasticity, we applied the logarithm to all variable.

Firstly, we check if all variables are stationary or not. The Augmented Dickey–Fuller tests (F-ADF) and Philips–Perron (PP) tests are used to verify the stationarity. Secondly, we test the existence of a long-run cointegrating relationship between the variables. This is done by the use of the Johansen (1988) cointegration test. Thirdly, a vector error correction model (VECM) method suggested by Engle and Granger (1987) is used if all variables are integrated of order one I (1) and cointegrated. If all variable is not cointegrated, Vector autoregressive (VAR) is more suitable. The empirical performed in this study is as follow:

$$LNC_{it} = \propto_i LNC_{i_{t-1}} + \beta_{i1} LNY_{i_t} + \beta_{i2} LNFD_{i_t} + \beta_{i3} LNURB_{i_t} + \beta_{i4} LNOPEN_{i_t} + \varepsilon_{it}, \quad (1)$$

where i indicates the countries (i=1, …, 6) and t indicates the time period (t = 1995, …, 2016). LNC, LNY, LNFD, LNURB, and LNOPEN represent natural logarithms of CO_2 emissions, income and financial development, urbanization, and trade openness respectively. Definition of variables were shown in Table 1. Under the EKC hypothesis, the signs of β_1 and β_2 are expected to be positive and negative, respectively, in order to reflect the inverted U-shape pattern.

3.3. Empirical results and discussions

3.3.1. Unit root tests

In our study, we use the Augmented Dickey–Fuller (F-ADF) unit root tests to check the stationarity of each variable. After that we advance the augmented Dickey–Fuller (ADF) statistic. The more negative it is the stronger for the rejection of the hypothesis demonstrates that there is a unit roots at some level of confidence. The results of the Augmented Dickey-Fuller (*ADF*) and Phillips-Perron (*PP*) tests for the five variables of the model are presented in Table 2. The results shown that in the level, the null hypothesis cannot be rejected for all the variables for both the two-unit root test ADF and (Phillips and Perron, 1988) PP test. LNC, LNY, LNFD, LNURB and LNOPEN are not stationary in the level. By testing through first difference, the results rejected the null hypothesis of non-stationarity. The unit roots tests confirm that each variable is integrated of order one.

Table 1: Definition of variables

Variable	Definition	Measurement
LNC	Natural logarithms of CO_2 emissions	CO_2 emissions (metric tons per capita)
LNY	Natural logarithms of income	Revenue, excluding grants (% of GDP)
LNFD	Natural logarithms of financial development	Domestic credit to private sector by banks (% of GDP))
LNURB	Natural logarithms of urbanization	% Urban population of total
LNOPEN	Natural logarithms of trade openness	Total imports + total exports of goods and services as % of GDP

3.3.2. Cointegration test and results

The cointegration test aims to check whether it exist a long run relationship association. Two statistics are used in the cointegration test of Johansen (1988), they are Trace test and Max-Eigen value. Table 3 presents the results of the trace and the maximum-eigenvalue tests from the Johansen (1980) and Johansen and Juselius (1990) maximum Likelihood analysis. The results given in Table 3 below suggest the existence of one cointegration vectors at 5% of significance for the Trace test and for the Max-eigenvalue. This result indicates that there is a long run association and consequently, the VECM model is appropriate to estimate our equation.

Table 2: Augmented dickey-fuller (*ADF*) and Phillips-Perron (*PP*) unit root tests

	ADF		PP		Order of Integration
	Level	1st diff,	Level	1st diff,	
LNC	-2,9314 [-4.186]	-9.821 [-4.192]	-3.305 [-4.186]	-10.5844 [-4.192]	I(1)
LNY	-3.8031 [-4.186]	-8.1710 [-4.1923]	-3.808 [-4.186]	-8.171 [-4.192]	I(1)
LNFS	-1.2545 [-4.186]	-10.029 [-4.1923]	-2.1914 [-4.186]	-10.3736 [-4.192]	I(1)
LNURB	-1.0344 [-4.186]	-5.4813 [-4.1923]	-1.4248 [-4.186]	-5.5691 [-4.192]	I(1)
LNOPEN	-1,7845 [-4.186]	-7.2251 [-4.192]	-4.1258 [-4.186]	-9.3352 [-4.192]	I(1)

Table 3: Results for Johansen (1990) test of cointegration hypothesized

N⁰. of CE (s)	Trace test		Max-eigenvalue test	
	Trace Statist.	Critical Value	Max-Eigen St.	Critical Value
None *	52.6104	47.21	30.0253	27.07
At most 1	22.5851	29.68	12.9034	20.97
At most 2	9.68166	15.41	9.6816	14.07
At most 3	2.27 E-05	3.37	2.27 E-05	3.76

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level; Max-eigenvalue test indicates 1 cointegration eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level

The Findings of the cointegration tests indicate the existence of relationships between variables. Therefore, all the variables are cointegrated. Table 4 presented the normalized long-run relationship based on the model (1). The coefficients in the long-run relationship are long-run elasticity's.

Table 4: Long-run association results

Variables	FDI	OPEN	INFRA
Coefficients	3.722206	0.360618	0.101179
Std.Error	(0.80424)	(0.12008)	(0.05384)
T-Statistic	[4.62820]***	[3.00317]***	[1.87923]**
C	29.11717		

** and ***: denote level of significance at 5% and 1% respectively

The long-run relationship between carbon dioxide emissions, financial development, trade, real GDP, and urbanization using the panel cointegration technique due to Pedroni (2004) reveals a a strong evidence that each panel series is integrated I (1).

The trade openness acts positively and significantly on income, finance development and urbanization. Trade openness promotes the efficient allocation of resources through comparative advantage, allows the dissemination of knowledge and technological progress, and encourages competition in domestic and international markets.

Our finding is consistent with the studies of Romer (1993), Grossman and Helpman (1991), and Saidi and Mbarek (2017). The variable (C) exerts a positive and significantly effect of income and finance development.

4. Discussion

The purpose of this paper is to study the relationship between income, trade, urbanization, and financial development on carbon dioxide emissions. The sample chosen for this context is a panel data from the GCC countries during the period from 1995 to 2016. We used the Augmented Dickey–Fuller (F-ADF) unit root tests to check the stationarity of each variable and the tests of Phillips-Perron (*PP*).

Further, the Results for Johansen (1990) test of cointegration denote the existence of relationships between variables. These results devoted a relationship and a positive effect between the variables. In fact, income exerts a positive effect on the trade openness, that's promotes positively the finance development and urbanization. And, it leads for a higher level of carbon dioxide emissions. Our findings conforms to Boutabba (2014), Chang and Li (2017), Bekhet and Othman (2017), and Bhattacharya et al. (2017) results. Otherwise, the results proved firstly, a relationship between income, trade, urbanization, financial development and CO_2 emissions, which is confirming the first hypothesis. Secondly, the results shown a higher level of country income generates a high level of CO_2 emissions (H2) Thereafter, a higher level of country Urbanization generates a high level of CO_2 emissions (H3) and Financial Development has a positive effect on CO_2 emission level (H4) Finally, the results prove that Openness trade influences positively the CO_2 emissions, this infirm the fifth hypothesis (H5).

5. Conclusion and policy remarks

This paper investigated the relationship between income, trade, urbanization, and financial development on carbon dioxide emissions for a panel of GCC countries for the period 1995–2016.

Our findings demonstrate that there is a long term relationship between income, trade, urbanization, financial development and CO_2 emissions. This relation is positive and significant.

Also the results denote that a higher level of country income and urbanization generates a high level of CO_2 emissions. Afterward financial Development had a positive effect on CO_2 emission level**.** And finally, trade openness influences negatively the CO_2 emissions.

Theoretically, the linkage Income, Trade, Urbanization, and Financial Development on CO_2

emissions was resumed in different context and different conclusions.

The works of Ahmad et al. (2017), Bekhet and Othman (2017), Bhattacharya et al. (2017), Chang and Li (2017), and Dogan and Aslan (2017) advertised a relation between the variables of our study.

In which, this authors prove empirically that there is a long-run regression between income, trade, urbanization, financial development and CO_2 emissions.

This finding may be considered of great interest, the GCC countries must limit the rate of CO_2 emissions, by establishing a new strategies and politics anti-pollution. As far as the financial development promote positively the urbanization, the trade openness and the level of income.

Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

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